

Appendix F

Engineering Design File for the ARA-16 Radionuclide Tank Transportation

Engineering Design File

Waste Area Group 5 Remedial Design/Remedial Action – Phase 1

INEEL

Idaho National Engineering & Environmental Laboratory
BECHTEL BWXT IDAHO, LLC

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ENGINEERING DESIGN FILE

1. Project File No. 020991 2. Project/Task Waste Area Group 5 Remedial Design/Remedial Action - Phase 1

3. Subtask _____


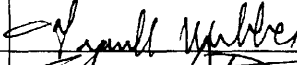
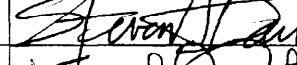
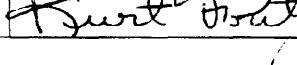
4. Title: Packaging and Transportation Analysis for WAG 5 RD/RA

5. Summary: It can be concluded with high confidence that all the materials resulting from the remedial actions for the ARA-02 Sanitary Waste System and ARA-16 Radionuclide Tank would be classified for transportation purposes as either unregulated, hazardous waste, radioactive LSA/SCO, or radioactive Type A quantity. For each of these classifications packaging is readily available commercially and is also stocked in the INEEL CFA warehouse.

6. Distribution (complete package):

Distribution (summary package only):

7. Review (R) and Approval (A) Signatures: (Minimum reviews and approvals are listed. Additional reviews/approvals may be added as necessary.)

	R/A	Printed Name	Signature	Date
Author		Gene Kanemoto		5/31/00
WAG 5 Project Manager	A	Frank Webber		6/1/00
Project Engineer	R	Steve Davies		6/01/00
Technical Coordinator	R	Kurt Fritz		6/1/00

1. INTRODUCTION

This EDF provides an evaluation on the packaging and transportation requirements for the waste materials resulting from the remedial actions for ARA-02 Sanitary Waste System and ARA-16 Radionuclide. Calculations were performed to determine the proper Department of Transportation (DOT) classification for the ARA-02 sanitary sewer system and the ARA-16 waste tank, contents and piping. These results, as well as a summary of the requirements, limitations and restrictions associated with the recommended DOT classifications, are presented. One of the bases used in selecting the classification was to minimize the packaging requirements.

Note: All sections of 49 CFR referenced in this EDF are contained in Attachment 1 for easy reference.

2. DEFINITIONS

The DOT has specific definitions for words and phrases that are used in this EDF. These words and phrases are listed below. The definitions are contained in 49 CFR 171.8 and 49 CFR 173.403.

49 CFR 173.403

A₂
Closed transport vehicle
Exclusive use
Limited quantity radioactive material
Low Specific Activity (LSA) Material
Low toxicity alpha emitter
Non-fixed radioactive contamination
Normal form radioactive material
Package
Packaging
Radiation level
Radioactive material
Surface Contaminated Object (SCO)
Transport Index

49 CFR 171.8

Bulk packaging
Division
Hazard class
Hazardous material
Hazardous waste
Liquid
Non-bulk packaging
Outer packaging
Overpack
Packing group
Siftproof packaging

3. ASSUMPTION

The evaluations assumed that all the materials were radioactive and/or hazardous waste (DOT Hazard Class 7 and 9) and that no other Hazard Class/Division applied. The other Hazard Class/Divisions are listed in 49 CFR 173.2 with the references to the defining sections in 49 CFR.

4. DISCUSSION

4.1 Packaging Requirements for Hazardous Waste DOT Class 9

49 CFR 172.101 specifies that the packaging of solid hazardous waste be in accordance with 49 CFR 173.213 for non-bulk packaging and 49 CFR 173.240 for bulk packaging. For non-bulk

packaging DOT UN performance based packaging at the Packaging Group III level would be required. This packaging is readily available commercially in various types (metal or poly drums, fiberboard boxes, wooden boxes, etc.). Suitable packaging of various types is also stocked in the CFA Warehouse.

The bulk packaging requirements in 173.240 are minimal. Closed or open top (per special provision B54 in 172.102) siftproof railcars, siftproof closed transport vehicles, or siftproof closed bulk bins may be used. This provides wide latitude in the use, if desired, of intermediate non-bulk or bulk packaging since reliance is placed on the conveyance to satisfy the DOT packaging requirements.

- Note: 1. Liquid hazardous waste packaging requirements are not addressed here since the only liquids involved in ARA-02 and ARA-16 are clearly radioactive.
2. If the hazardous waste is also DOT radioactive material it must be classified and packaged for transportation as radioactive material. DOT Class 7 (radioactive material) takes precedence over Class 9 (hazardous waste) requirements.

4.2 Packaging Requirements for LSA and SCO Radioactive Material

The radioactive materials from ARA-02 and ARA-16 were evaluated and it was determined that they meet the DOT requirements to be classified as Low Specific Activity (LSA) material and Surface Contaminated Objects (SCO). The packaging requirements for these radioactive material classifications are specified in 49 CFR 173.427. The minimum packaging authorized [173.427(b)(3)] is a "strong, tight" container that will not leak its contents under normal transport conditions, and satisfies the general packaging requirements contained in 173.24, 173.24a (non-bulk packaging), 173.24b (bulk packaging), and 173.410. These requirements are minimal and are generally easily satisfied. However, one requirement that warrants specific mention in this EDF, since it could require specific engineering evaluation, is 49 CFR 173.410(b), which states:

"Each lifting attachment that is a structural part of the package must be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and it must be designed so that failure of any lifting attachment under excessive load would not impair the ability of the package to meet other requirements of this subpart."

Suitable packaging is readily available and is stocked in the CFA Warehouse, including closed head drums for liquids, and open head drums and metal 4 ft x 4 ft x 8 ft boxes for solids.

4.3 General Radiation Requirements and Limitations

LSA/SCO Material:

1. The radioactivity (curies) contained in a strong, tight package is limited to an A_2 value. The A_2 values for single radionuclides are listed in 49 CFR. For mixtures of radionuclides the A_2 value must be calculated on a case by case basis in accordance with the requirements specified in 49 CFR 173.433.

2. The external dose rate must not exceed 1000 mR/hr at 3 meters from the unshielded material
3. Shipments of LSA/SCO in strong, tight packaging must be made exclusive use.

Radiation Level Limits: The radiation level limits are specified in 49 CFR 173.441 and are summarized here.

1. The general limits are 200 mR/hr on the external surface of the package and the transport index should not exceed 10 (10 mR/hr at 1 meter from the package).
2. For shipments made exclusive use the above limits can be increased to 1000 mR/hr on the external surface of the package (requires closed transport vehicle), 200 mR/hr on the outer surfaces of the vehicle or vertical planes projected from the outer edges of an open vehicle, and 10 mR/hr at 2 meters from the lateral surfaces of the vehicle or lateral planes projected from the outer edges of an open vehicle.

Radioactive Contamination Limits: The non-fixed radioactive contamination limits on the exterior of the package are specified in 49 CFR 173.443. The limit for beta, gamma, and low toxicity alpha emitters is 22 dpm/cm² and 2.2 dpm/cm² for all other alpha emitters. Higher limits are allowed under special provisions and 173.443 should be consulted directly for these should it be necessary.

4.4 Criteria for LSA and SCO Determination

LSA and SCO are defined in 49 CFR 173.403. LSA has three groups. The applicable group for the ARA-02 and ARA-16 LSA materials is LSA-II which requires:

“...Class 7 (radioactive) material is distributed throughout and the average specific activity does not exceed $10^{-4} A_2/g$ for solids and gases, and $10^{-5} A_2/g$ for liquids.”

SCO has two groups, SCO-I and SCO-II. The primary distinction between the two is the level of packaging required for greater than A_2 quantities in a single package. If the content of a single package is limited to an A_2 quantity there is essentially no difference in the requirements between SCO-I and SCO-II. Minimum packaging required is “strong, tight” for both. The highest contamination limits are for SCO-II and are summarized in the table below. These levels are averaged over 300 cm² or the area of the surface if less than 300 cm².

	Beta, Gamma, Low Toxicity Alpha Emitter	Other Alpha Emitters
Non-fixed contamination accessible surface	400 Bq/cm ²	40 Bq/cm ²
Fixed contamination accessible surface	8×10^5 Bq/cm ²	8×10^4 Bq/cm ²
Non-fixed plus fixed contamination on inaccessible surfaces	8×10^5 Bq/cm ²	8×10^4 Bq/cm ²

- Note:
1. 1 Bq = 1 disintegration per second.
 2. Contamination can be defined as the presence of a radioactive substance on a surface in excess of 0.4 Bq/cm² for beta, gamma, and low toxicity alpha emitters; or 0.04 Bq/cm² for all other alpha emitters.

4.5 Load Securement Requirements

The DOT Federal Motor Carrier Safety Regulations (FMCSR) specifies the load securement requirements in 49 CFR 393.100 through 104. 49 CFR 393.102(b), Tiedown assemblies, is applicable to securing large items as waste tanks.

5. EVALUATION OF ARA-02 MATERIALS

5.1 Seepage Pit Sludge

The maximum radionuclide concentrations (DOE-ID 2000a, pp. A-7 and A-8), were used in determining if the seepage pit sludge was DOT radioactive. Based on these maximum concentrations, this material would be only marginally DOT radioactive with a total specific activity of 2.168 nCi/gm compared to the 2 nCi/gm threshold value for radioactive material. With more detailed evaluations of the sampling data it may be possible to conclude that the material is not radioactive.

If the material is radioactive it will satisfy LSA criteria. The minimum packaging requirement is a strong, tight package as discussed above. Based on the most restrictive A₂ value for the radionuclides listed, over 2400 kg of the sludge can be placed in a single strong, tight package. If it is concluded that the seepage pit sludge is not radioactive it must be packaged as hazardous waste, DOT Class 9, as discussed above.

- Note: The calculations for radioactive material determinations for this and other classifications in this EDF were performed using the RADCALC computer program. The printouts are contained in Attachment 2.

5.2 Cinder Blocks and Gravel, and Three Tanks and Pipes

For transportation purposes these materials are either radioactive, hazardous waste, or not regulated. The packaging requirements for hazardous waste is as discussed above; for non-regulated material the packaging should be in accordance with good business practices. For radioactive material the packaging requirements are dependent on its specific classification. Specific information concerning radioactive contamination levels, which is necessary to determine this classification, was not provided in the referenced reports. However, it can be rationalized with high confidence that if these materials are radioactive, they will satisfy LSA/SCO criteria, with its minimal packaging requirements.

Assuming that the radionuclide mixture for the seepage pit sludge is representative of the contamination in the cinder blocks, gravel, tanks, and pipes, a rough estimate of the radiation levels that would be emitted from these materials if contaminated to allowed limits for LSA/SCO can be made. These calculations are contained in Attachment 3. The results of the calculations indicate that at the allowed limits, significantly higher dose rates can be expected than were experienced in the

field during the removal of the septic tank contents and seepage pit sampling activities in 1996.^a It can be concluded that in the worst case these materials are LSA/SCO

6. EVALUATION OF ARA-16 RADIONUCLIDE TANK

6.1 Tank and Contents

The contents of the ARA-16 tank were evaluated on RADCALC to determine the appropriate DOT classification. The maximum concentrations provided in Table 26 of the Waste Area Group 5 Record of Decision (DOE-ID 2000b) were decayed three years to represent the actual activities in year 2000. An adjustment was made to the data for the sludge to include 229 pCi/g U-235 based on the assumption that the relatively high concentration of U-234 raised the detection level for U-235.^b It was assumed that there are 312 gallons of liquid and 4.5 gallons of sludge. The specific gravity of the liquid was assumed to be 1 and that of the sludge to be 1.19. Based on these assumptions it was determined that the tank contents satisfied LSA criteria and the total activity was below an A₂ value. Note that if the sludge were evaluated separately it would exceed the allowed specific activity for LSA by a factor of 2. It is assumed that in conjunction with the water, there is additional dilution of the sludge. Further, LSA-II requires that the "average specific activity" not exceed 10⁻⁵ A₂/g. It is not required that the activity be homogeneously distributed and reasonable latitude is allowed.

As discussed above, the minimum packaging requirement is a strong, tight package. The ARA-16 radionuclide tank could satisfy this requirement. If the tank is to be used as the transport packaging, it is strongly recommended that appropriate inspections and evaluations be performed. These should include inspections of all welds to appropriate acceptance criteria and evaluation of all stresses that could result during normal conditions of transport (e.g., stresses resulting from tiedowns, vibration and vibration resonance, acceleration, and the sloshing of the contents of the tank), to assure adequate structural integrity so that there will be no leakage of contents during transport. Appropriate supports for the tank on the transport vehicle will need to be provided and the tank tied down in accordance with 49 CFR 393.102. Any lifting attachments or features on the tank that could be used as lifting attachments must be evaluated against the criteria of 173.410(b) and any necessary modifications made. Additional precautions, though not required by regulations, could include:

1. Shrink wrapping the tank for contamination control
2. Enclosing the tank with a lined enclosure with absorbents to contain minor leakage

The total activity of the tank contents (primarily Co-60 and Cs-137) and dose rate measurements taken during prior sampling activities indicate that the general package contact dose limit of 200 mR/hr will be exceeded on the tank. There are also dose rate measurements previously taken that indicate that the 1000 mR/hr contact dose limit for exclusive use shipments in enclosed vehicles may be exceeded. A number of options are available.

1. If the contact dose is between 200 mR/hr and 1000 mR/hr the shipment can be made in a closed transport vehicle.

a. Telecon with John Marthis, April 20, 2000.

b. Lotus Notes from Richard P. Wells, May 25, 2000

2. If the contact dose exceeds 1000 mR/hr the tank can be placed within an outer packaging. The package dose rate limits would apply to the outer packaging. Dose rate reductions can be achieved through additional distance and/or the outer packaging can be designed with shielding to achieve the necessary dose reductions. Any shielding would need to be designed so that under conditions of normal transport there will be no increase in radiation levels that would cause the applicable dose rate limits for the shipment to be exceeded.
3. The tank can be partially emptied of contents to reduce the dose rates to within regulatory limits. The contents removed from the tank would still be classified as LSA and less than an A₂ value. The emptied contents can be placed in steel drums. If shielding is required the drums can be shipped in a shielded container such as the CNS 14-190 cask, which is available at the INEEL and will hold fourteen 55-gallon drums.

Note: Agitating the liquid prior to content removal is recommended because if only the liquid portion of the contents is removed, the remaining portion may consist mostly of sludge and could exceed LSA criteria.

4. The tank can be completely emptied of contents and be packaged and shipped as a SCO. This may require decontamination to SCO limits. The tank contents would be shipped as discussed in item 3.

6.2 ARA-16 Piping

Specific information concerning radioactive contamination in the ARA-16 piping, on which to base a DOT classification, was not provided in the referenced reports. A rough estimate of the dose rates that would be emitted by the piping if contaminated to the SCO limits was calculated for comparison with field measurements (see Attachment 3). The measured dose rates on the piping ranged from approximately 10 mR/hr to 50 mR/hr^c. These measured dose rates are within the dose rates calculated for the piping contaminated to the SCO regulatory limit, but are of the same order of magnitude. It is likely that the piping will be within SCO limits, but the possibility of exceeding the SCO limits cannot be dismissed. Field measurements will be necessary prior to packaging and shipment to confirm that the piping satisfies SCO criteria.

The minimum packaging requirements for SCO is "strong, tight" as discussed above. Should the piping exceed SCO limits a number of options are available:

1. The piping can be decontaminated to SCO limits.
2. The piping can be packaged in DOT Spec 7A Type A packaging and shipped as a Type A quantity shipment (limited to an A₂ quantity). DOT Spec 7A Type A packaging is stocked in the CFA warehouse (55 and 85 gallon steel drums). Other DOT Spec 7A Type A packaging that may be more suitable is available with additional lead-time for procurement.

c. Telecon with John Marthis, April 20, 2000.

7. REFERENCES

DOE-ID, 2000a, April 2000, "Field Sampling Plan for the Waste Area Group 5 Remedial Action – Phase 1 (Draft)," DOE/ID-10758, U.S. Department of Energy, Idaho Operations Office.

DOE-ID, 2000b, January 2000, *Record of Decision for the Power Burst Facility and Auxiliary Reactor Area*, DOE/ID-10700, U.S. Department of Energy, Idaho Operations Office.